

Technical information: Using heat sinks for speaker units

Wavecor makes a number of speaker units using neodymium magnets.

For tweeters this is a cost effective way of reaching the desired parameters, and the only way to obtain sufficient motor power - and at the same time ensuring a compact and lightweight design.

Neodymium tweeters are very well suited for AV applications, where the large magnetic stray field from a ferrite motor would prevent using it close to a traditional TV screen.

Today neodymium powered tweeters are almost 100% dominating the automotive market because of favourable size.

Neodymium magnets are also applicable for woofers, where they offer smaller size and lower weight than ferrite magnets for the same performance in terms of efficiency and T/S parameters. Neodymium magnet woofers are for instance well suited for AV because magnetic shielding comes by design.

Due to smaller size they are also preferred for automotive applications.

Using neodymium magnets for woofers and mid/woofers also offer some real benefits in terms of sound. As an example, the same woofer would have a larger voice coil inductance (L_e) if fitted with a ferrite magnet structure than if using neodymium magnet. The lower L_e and maybe more importantly, the lower absolute L_e variation following cone movements, makes the neodymium motor powered woofer sound better.

HOWEVER, there is a price to pay for using neodymium magnets!

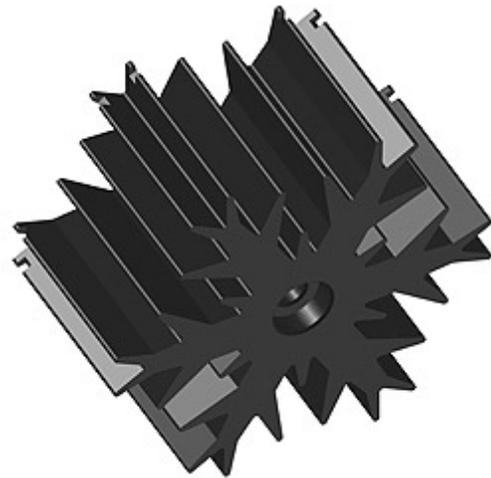
Due to the smaller size neodymium magnets yield lower power handling than a large ferrite motor does. The limitation occurs because of the smaller surface area and thereby poorer transfer of heat to the surrounding air.

A common speaker failure mode is overheating of the voice coil.

For all speaker units the largest portion of the input power is converted to heat generated in the voice coil. In order not to reach damaging voice coil temperatures, it is important that the heat be quickly and easily transferred into the magnet parts and from there on to the air. In other words, there has to be good heat conductance from the voice coil all the way into the surrounding air.

Transferring heat through the metal parts is relatively easy but there is a large barrier transferring it further on to the air.

The single most important factor getting the heat away into the air is the surface area.



Above: Heat sink used on several Wavecor tweeters like for instance TW030WA01/02 and TW030TU01

Below: Complete woofer magnet structure including heat sink. For instance used on WF138WA01, WF132TU01, WF166TU01, and WF160WA01



Another important role plays the colour of the parts that transfer the heat on to the air. Black is the best colour in this respect, which is the reason why most heat sinks are black. It's the same reason why Wavecor uses black colour for most of all magnet parts, voice coil formers, and, of course, heat sinks. All Wavecor standard drivers with neodymium motor use heat sinks because we were simply not satisfied with the power handling capabilities without the heat sinks.

There are, however, still speaker units in the market with neodymium magnet without heat sinks. Lower long term power handling is the consequence.

As an example, the heat sink we use on our 30mm neodymium tweeters increases the effective directly radiating surface area from 20 sq.cm to over 99 sq.cm, or a stunning increase of 400%. Although this does not mean that the power handling goes up 5 times, it does make a huge difference in keeping the voice coil temperature down.

Another example is the neodymium motor we use for some of our 4", 5" and 6" woofer, where the heat sink allows an increase in heat transferring metal area to 225 sq.cm, which is almost the same area as a large 90mm ferrite motor has.

Having taken this approach to eliminate heat problems using neodymium magnets, the most import technical problem using neodymium has been solved.

We have even taken it a step further by the way our heat sinks are designed and manufactured. It would be a simple process for us to increase the length of the heat sinks, in which case the surface area might be increased even much further resulting in even higher power handling if required.

The result is that by using our custom made heat sinks for all neodymium models Wavecor is able to offer neodymium powered drivers with all the benefits of using neodymium magnets but without loosing out on power handling.

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